

Listing of Claims:

Claims 1-38 (Canceled).

39. (New) An optical displacement sensor for measuring a displacement of a scale, wherein the scale is movable in a predetermined direction and includes a diffraction grating which has a predetermined period in a direction of the predetermined direction, said optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam to the diffraction grating such that a principal axis of the light beam is perpendicular to the direction of the predetermined direction and inclines at a predetermined angle relative to a line perpendicular to a surface of the diffraction grating within a plane perpendicular to the direction of the predetermined direction; and

a photosensor for detecting a specific portion of a diffraction interference pattern which is generated by interaction of the light beam and the diffraction grating, wherein the photosensor comprises a plurality of light detecting areas arranged at intervals of approximately

$$np1(z1 + z2)/z1$$

in a spatial period direction of the diffraction grating on the scale;

where:

z1 is an optical distance along the principal axis of
the light beam from a beam emitting surface of the
surface emitting laser light source to a scale
surface where the diffraction grating is formed;

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z2 is an optical distance along the principal axis of
the light beam from the scale surface to the
photosensor;

p1 is a spatial period of the diffraction grating; and
n is a natural number.

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40. (New) The optical displacement sensor according to
claim 39, wherein the surface emitting laser light source and the
photosensor are separated from the scale by approximately equal
optical distances and are arranged on a same side of the scale.

41. (New) The optical displacement sensor according to
claim 40, wherein the scale surface where the diffraction grating
is formed is parallel to a light receiving surface of the
photosensor.

42. (New) An optical encoder comprising:
a surface emitting laser light source;

a scale supported to be movable in a predetermined direction and formed with a first scale pattern and a second scale pattern which are arranged in parallel in the predetermined direction;

a beam-splitting optical element provided between the surface emitting laser light source and the scale, for splitting a light beam emitted from the surface emitting laser light source into a first light beam and a second light beam, wherein the first light beam and the second light beam are at least one of reflected, diffracted, and passed by the scale;

a first photosensor for detecting a specific portion of a diffraction interference pattern which is generated by interaction of the first light beam and the first scale pattern, wherein the first photosensor comprises a plurality of light detecting areas arranged at intervals of approximately

$$np11(z11 + z21)/z11$$

in a spatial period direction of the first scale pattern on the scale;

where:

z11 is an optical distance along a principal axis of the first light beam from a beam emitting surface of the surface emitting laser light source to a scale surface where the first scale pattern is formed;

z21 is an optical distance along the principal axis of
the first light beam from the scale surface where
the first scale pattern is formed to the first
photosensor;

30 p11 is a spatial period of the first scale pattern; and
n is a natural number; and

a second photosensor for detecting a specific portion of the
second light beam which is generated by interaction of the second
light beam and the second scale pattern.

43. (New) The optical encoder according to claim 42,
further comprising:

a first optical beam-bending element provided between the
scale and the first photosensor; and

5 a second optical beam-bending element provided between the
scale and the second photosensor;

wherein the first and second light beams which have been
optically affected by the first scale pattern and the second
scale pattern pass through the first and second optical
10 beam-bending to be received by the first and second photosensors,
respectively.

44. (New) The optical encoder according to claim 42,
wherein the beam-splitting optical element is disposed in such a

way as to include the principal axis of the light beam immediately after the light beam has been emitted from the light source and to split the principal axis of the light beam into a plurality of directions only in a plane perpendicular to a pitch direction of the first scale pattern.

45. (New) The optical encoder according to claim 42, wherein the second scale pattern has at least one of a uniform reflectance, transmissivity and diffraction efficiency.

46. (New) The optical encoder according to claim 42, wherein the second scale pattern has a predetermined period p_{12} which is different from the spatial period p_{11} of the first scale pattern, and the second photosensor comprises a plurality of light receiving areas formed at intervals of approximately

$$np_{12}(z_{12} + z_{22})/z_{12}$$

in a spatial period direction of the diffraction interference pattern;

where:

z_{12} is an optical distance measured along a principal axis of the second light beam that extends from the beam emitting surface of the surface emitting laser light source to a scale surface where the second scale pattern is formed; and

15 z22 is an optical distance measured along the principal
 axis of the second light beam that extends to a
 light receiving surface of the second photosensor
 from the scale surface where the second scale
 pattern is formed.

47. (New) The optical encoder according to claim 42,
wherein the second scale pattern comprises one of a single scale
pattern and a plurality of scale patterns formed at a
predetermined reference position.

48. (New) An optical encoder according to claim 43, wherein
the beam-splitting optical element and the first and second
optical beam-bending elements are disposed in such a way as to
include the principal axis of the light beam immediately after it
5 has been emitted from the coherent light source and to split the
principal axis of the light beam into a plurality of directions
only in a plane perpendicular to a pitch direction of the first
scale pattern.

49. (New) An optical encoder according to claim 43, wherein
the second scale pattern has at least one of a uniform
reflectance, transmissivity and diffraction efficiency.

50. (New) An optical encoder according to claim 43, wherein the second scale pattern has a predetermined period p12 different from the spatial period p11 of the first scale pattern, and the second photosensor comprises a plurality of light receiving areas
5 formed at intervals of approximately

$$n p_{12}(z_{12} + z_{22})/z_{12}$$

in the spatial period direction of the diffraction interference pattern;

where:

10 z12 is an optical distance measured along a principal axis of the second light beam that extends from the beam emitting surface of the coherent light source to a scale surface where the second scale pattern is formed; and

15 z22 is an optical distance measured along the principal axis of the second light beam and extending to a light receiving surface of the second photosensor from the scale surface where the second scale pattern is formed.

51. (New) An optical encoder according to claim 43, wherein the second scale pattern comprises one of a single scale pattern and a plurality of scale patterns formed at a predetermined reference position.

52. (New) An optical displacement sensor for measuring a displacement of a scale which is movable in a predetermined direction, said optical displacement sensor comprising:

first and second scale patterns formed on the scale and arranged in parallel to the predetermined direction, wherein at least the first scale pattern includes a diffraction grating having a predetermined period in a direction of the predetermined direction;

a surface emitting laser light source for emitting first and second light beams to the first and second scale patterns, respectively, such that a principal axis of each of the first and second light beams is perpendicular to the direction of the predetermined direction and is inclined at a predetermined angle only within a plane perpendicular to the direction of the predetermined direction; and

a photosensor including first and second photosensors;

wherein the first photosensor includes a plurality of light detecting areas in a pitch direction of the diffraction grating, and the first photosensor is designed to detect a specific portion of a diffraction pattern which is generated by interaction of the first scale pattern and the first light beam, and the plurality of light detecting areas are arranged at intervals of approximately

$$np11(z11 + z21)/z11;$$

pl1 is a pitch of the diffraction grating in a moving
direction thereof;

z11 is an optical distance along the principal axis of
the first light beam from the surface emitting

laser light source to the first scale pattern; and
z21 is an optical distance along the principal axis of
the first light beam from the first scale pattern
to a light detecting surface of the first
photosensor;

wherein the second photosensor is designed to detect a specific portion of a light beam pattern which is generated by interaction of the second scale pattern and the second light beam; and

wherein the surface emitting laser light source and the photosensor are arranged on a same side of the scale, and a surface of the scale is parallel to light receiving surfaces of the first and second photosensors of the photosensor unit.